

SCOTT BAUER (K10746-1)

# Flowering Alfalfa Breaks Barriers

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Close-up of the flower of falcata.

“It all started around 1915 after a traveling scientist gave a handful of seeds to a local homesteader,” says soil scientist Gerald E. Schuman. He is with the ARS Rangeland Resources Research Unit, High Plains Grasslands Research Station, in Cheyenne, Wyoming. Schuman is talking about a yellow-flowering subspecies of alfalfa, *Medicago sativa* ssp. *falcata*, known today simply as falcata, a plant that ranchers and others told him was thriving in the Northern Plains.

Recently, since word has spread of the plant’s success, falcata has received interest from farmers, ranchers, and researchers who want more information.

Falcata covers about 1,500 known acres east of Lodgepole, South Dakota, on the ranch owned by Norman “Bud” Smith and his son, Tim. They are descendants of the homesteader who received the original seeds nearly a century ago.

“My great uncle started with just a small packet of seeds,” says Bud Smith. “Over several decades, it survived on the plains with virtually no help whatsoever.” Some time after taking over the land in the 1950s, Smith recognized the potential of falcata and nurtured it to harvest 5 pounds of seeds to plant. “I interseeded it, meaning I placed the alfalfa among my existing shrubs and grasses to increase forage production and palatability,” he says.

Alfalfa has long been known as a high-protein feed source for cattle. Trouble is, the hay varieties wither on the Northern Plains under nonirrigated conditions.

According to legend, the traveling scientist first noticed cows and sheep grazing the bright-yellow falcata on the Siberian plains near the Arctic Circle and brought the original seeds back home. Today, the Smiths attribute increased livestock numbers and weight gains without bloat to the fine-stemmed and fine-leaved falcata alfalfa, which they say the cattle prefer.

## At Home on the Range

A day in the life of a rangeland plant is marked by fierce competition for life-sustaining water. Some rangelands receive as few as 10 inches of rain per year. Ten years ago, scientists at the Cheyenne lab concluded that interseeding available varieties of alfalfa would be a good way to increase forage production and quality. But early attempts to interseed legumes on the rangelands showed little promise. “You could get it started, but it wouldn’t persist very long,” says Schuman. “Within 3 or 4 years it would die out.”

Then 3 years ago, Schuman visited the Smith ranch and saw the proliferating, interseeded areas of falcata alfalfa. Since then, Smith has become an eager volunteer collaborator in helping ARS scientists unlock the mysteries of falcata’s success.

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Rows of yellow-flowering falcata alfalfa interseeded into the native rangeland on the Smith Ranch near Lodgepole, South Dakota.



It seems that most U.S.-grown alfalfa varieties have a long, main root—called a taproot—that grows deep into the soil. Since 80 percent of neighboring plant species sink their roots in a more shallow, distributed network, those plants usurp water that otherwise could sustain alfalfa.

“But falcata has a more fibrous root system that’s unlike other alfalfas and more like grass,” says Schuman. “Falcata’s root system allows it to compete with native grasses and forbs for limited moisture.”

The lab has since been evaluating the effects of falcata on forage production, forage quality, and soil quality.

### Increases in Soil Nitrogen

Schuman’s team includes ARS physical science technician Matthew C. Mortenson and postdoctoral research associate Lachlan J. Ingram. They studied the Smiths’ various interseeded acres and found a large increase in forage production—at times nearly double—when compared to noninterseeded rangeland.

For Schuman, the find revived a stalled effort to pursue interseeding alfalfa into rangelands because of the legume’s natural ability to replenish nitrogen-poor soil. Alfalfa is able to obtain its nitrogen directly from the air, and under the right



Soil scientist Gerald Schuman (left) and rancher Norman Smith examine falcata interseeded on Smith’s farm.

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Lachlan Ingram (left), a postdoctoral research associate at the University of Wyoming, and Matthew Mortenson, an ARS physical science technician, take soil samples from rangeland where falcata has been interseeded. The soil samples will be used to assess the benefits of falcata on soil organic carbon and nitrogen.

## Falcata Shows Promise

conditions, alfalfa's nitrogen can boost nearby grass and forb production.

"A bacterium called *Rhizobium* forms nodules on roots of the alfalfa, and they convert nitrogen gas in the soil into a form of nitrogen that the plant can use," says Schuman.

On farmland where falcata had been interseeded for more than 3 years, large increases in soil nitrogen have been measured. And plant protein content in these areas has increased by as much as 30 percent.

### Closing in on Carbon

In addition to nitrogen fixation, the scientists are interested in the extent to which falcata influences carbon storage in the soil. The more carbon dioxide (CO<sub>2</sub>) that plants assimilate—which increases soil organic carbon and improves soil quality—the lower the levels of atmospheric CO<sub>2</sub>.

Schuman's team found a substantial increase in soil carbon—by more than 5 tons per acre on some falcata-interseeded rangelands—when compared to noninterseeded areas.

Plants take CO<sub>2</sub> out of the atmosphere and convert it, using sunlight and water, into carbohydrates. That process produces plant material, nearly half of which is carbon. "If a plant had a skeleton, it would be made out of carbon," says plant physiologist Jack Morgan, who is the research leader of the Cheyenne station. "It's the backbone of all organic material."

By increasing the soil's organic matter through plant residue decomposition, falcata essentially improves soil quality. "Carbon sequestration is the process in which CO<sub>2</sub> from the air is made into plant and root material and then eventually deposited into the soil during decomposition," says Schuman. "We call that form soil organic carbon."

### Winter-Weather Forage

Because falcata has been grazed successfully in winter, the researchers plan to take vegetation samples in late November to test its off-season forage quality.

Schuman says that unlike other alfalfas, falcata's stems are finer, providing cattle with forage in the chilly winter air. The researchers will test the November samples to measure falcata's protein content and gauge its nutritional quality as a feed source for cattle in the winter months.

"We'll continue to study falcata on the Smiths' ranch because of its tremendous potential to increase production and forage quality and to increase the amount of carbon that is stored in soil," says Schuman.

In the meantime, as word of the proliferating yellow-flowering alfalfa spreads, more ranchers are interested in using

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Using chamber technology, soil scientist Gerald Schuman (left) and technician Valerie O'Neil take measurement of nitrous oxide and methane emission from the soil in a rangeland field interseeded with falcata. These gases are very important contributors to global warming.

falcata as a means of increasing forage production.—By **Rosalie Marion Bliss**, ARS.

*This research is part of Global Change (#204) and Rangeland, Pasture, and Forages (#205), two ARS National Programs described on the World Wide Web at [www.nps.ars.usda.gov](http://www.nps.ars.usda.gov).*

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